Tuning topological superconductivity in helical Shiba chains by supercurrent.
Joel Rontynen and Teemu Ojanen
arxiv:1406.4288
Recent experimental investigations of arrays of magnetic atoms deposited on top of a superconductor have opened a new chapter in the search of topological superconductivity. We generalize the microscopic model derived by Pientka et al. [Phys. Rev. B 88, 155420 (2013)] to accommodate the effects of finite supercurrent in the host material. Previously it was discovered that helical chains with nonplanar textures are plagued by a gapless phase. We show that by employing supercurrent it is possible to tune the chain from the gapless phase to the topological gapped phase. It is also possible to tune the chain between the trivial and the topological gapped phase, the size of which may be dramatically increased due to supercurrent. For planar textures supercurrent mainly contributes to proliferation of the gapless phase. Our predictions, which can be probed in STM experiments, are encouraging for observation and manipulation of Majorana states.

On the superconductivity of graphite interfaces.
P.Esquinazi, T.T.Heikkila, Y.V. Lysogorskiy, D.A.Tayurskii, G.E.Volovik
Pisma v ZhETF, vol. 100, 374, (2014)
We propose an explanation for the appearance of superconductivity at the interfaces of graphite with Bernal stacking order. A network of line defects with flat bands appears at the interfaces between two slightly twisted graphite structures. Due to the flat band the probability to find high temperature superconductivity at these quasi one-dimensional corridors is strongly enhanced. When the network of superconducting lines is dense it becomes effectively two-dimensional. The model provides an explanation for several reports on the observation of superconductivity up to room temperature in different oriented graphite samples, graphite powders as well as graphite-composite samples published in the past.

Superconductivity and linear magnetoresistance of In-doped SnTe nanoplates.
Jie Shen, Yujun Xie, J.J. Cha
arxiv:1410.4244
SnTe is a topological crystalline insulator whose surface states are protected by crystal symmetry. Particularly, indium doping in SnTe induces superconductivity, making SnTe a candidate for a topological superconductor. SnTe nanostructures offer well-defined morphology and higher surface to volume ratios than bulks to enhance surface state effects. Thus, inducing superconductivity in SnTe nanostructures is crucial. Here, we demonstrate In-doped SnTe nanoplates via vapor-liquid-solid and vapor-solid growths. Superconductivity emerges below 2K for SnTe nanoplates with a $\approx 5\%$ In doping concentration. In addition, In-doped SnTe nanoplates show a clear weak antilocalization in low magnetic fields and a linear magnetoresistance in high magnetic fields. Angle-dependent transport measurements indicate that the observed weak antilocalization is a bulk effect as the feature overlaps completely for all angles of magnetic fields. Interestingly, the linear magnetoresistance is two-dimensional in nature based on the angle-dependent transport, suggesting its surface origin. The slope of the linear magnetoresistance appears temperature-independent up to $10K$, which is expected for surface states with linear dispersion.

Spin-transfer torque switching in nanopillar superconducting-magnetic hybrid Josephson junctions
B. Baek, W. H. Rippard, M. R. Pufall, S. P. Benz, S. E. Russek, H. Rogalla, and P. D. Dresselhaus
arxiv:1410.4529
The combination of superconducting and magnetic materials to create novel superconducting devices has been motivated by the discovery of Josephson critical current oscillations as a function of magnetic layer thickness and the demonstration of devices with switchable critical currents. However, none of the hybrid devices have shown any spintronic effects, such as spin-transfer torque, which are currently used in room-temperature magnetic devices, including spin-transfer torque random-access memory and spin-torque nano-oscillators. We have developed nanopillar Josephson junctions with a minimum feature size of 50 nm and magnetic barriers exhibiting magnetic pseudo-spin-valve behavior at 4 K. These devices allow current-induced magnetization switching that results in 20-fold changes in critical current. The current-induced magnetic switching is consistent with spin-transfer torque models for room-temperature magnetic devices. Our work demonstrates that devices that combine superconducting and spintronic functions show promise for the development of a nanoscale, nonvolatile, cryogenic memory technology.

Coherent coupling between ferromagnetic magnon and superconducting qubit.
Y. Tabuchi, S. Ishino, A. Noguchi, T. Ishikawa, R. Yamazaki, K. Usami, and Y. Nakamura
arxiv: 1410.3781
Here we demonstrate coherent coupling between a magnon excitation in a millimetre-sized ferromagnetic sphere and a superconducting qubit, where the interaction is mediated by the virtual photon excitation in a microwave cavity. We

obtain the coupling strength far exceeding the damping rates, thus bringing the hybrid system into the strong coupling regime. Furthermore, we find a tunable magnon-qubit coupling scheme utilizing a para- metric drive with a microwave.

Resonant tunneling of fluctuation Cooper pairs.
A. Galda, A. S. Melnikov, and V. M. Vinokur
arxiv:1410.2545
Superconducting fluctuations have proved to be an irreplaceable source of information about microscopic and macroscopic material parameters that could be inferred from the experiment. According to common wisdom, the effect of thermodynamic fluctuations in the vicinity of the super- conducting transition temperature, T_c, is to round off all of the sharp corners and discontinuities, which otherwise would have been expected to occur at T_c. Here we report the current spikes due to radiation-induced resonant tunneling of fluctuation Cooper pairs between two superconductors which grow even sharper and more pronounced upon approach to T_c. This striking effect offers an unprecedented tool for direct measurements of fluctuation Cooper pairs' lifetime, which is key to our understanding of the fluctuation regime. Our finding marks a radical departure from the conventional view of superconducting fluctuations as blurring and rounding phenomenon.

Changing the type of superconductivity by magnetic and potential scattering.
V. G. Kogan, R. Prozorov
arxiv:1410.4605
By evaluating the upper and thermodynamic critical fields, H_{c2} and H_c, and their ratio H_{c2}/H_c at arbitrary temperatures, we argue that situations are possible when a type-II material is transformed to type-I by adding magnetic impurities.

Breakdown of Three-dimensional Dirac Semimetal State in pressurized Cd_3As_2.
Shan Zhang et al.
arxiv:1410.3213
Here, we report the first observation of a pressure-induced breakdown of the 3D-DSM state in Cd_3As_2. In-situ synchrotron X-ray and single crystal resistance measurements find that Cd_3As_2 undergoes a structural phase transition from a metallic tetragonal phase to a semiconducting high pressure phase at 2.57GPa; the phase transition breaks the semimetal state. Applying pressure around the phase transition, we observe unusual physical phenomena, including dramatic changes in mobility, Hall resistance and magnetoresistance in addition to the gap opening, which demonstrate the breakdown of the 3D-DSM state. Furthermore, an intermediate state found near the boundary of the phase transition appears to signify the emergence of a novel quantum phase between the low pressure and high pressure phases.

Unified Topological Field Theory for Gapped and Gapless Systems.
D. Bulmash, P. Hosur, S.-C. Zhang, X.-L. Qi
arxiv:1410.4202
We derive a scheme for systematically enumerating the responses of gapped as well as gapless systems of free fermions to electromagnetic and strain fields starting from a common parent theory. Using the fact that position operators in the lowest Landau level of a quantum Hall state are canonically conjugate, we consider a massive Dirac fermion in 2n spatial dimensions under n mutually orthogonal magnetic fields and reinterpret physical space in the resulting zeroth Landau level as phase space in n spatial dimensions. The bulk topological responses of the parent Dirac fermion, given by a Chern-Simons theory, translate into quantized insulator responses, while its edge anomalies characterize the response of gapless systems. Moreover, various physically different responses are seen to be related by the interchange of position and momentum variables. We derive many well-known responses, and demonstrate the utility of our theory by predicting spectral flow along dislocations in Weyl semimetals.